Kinematics Analysis of Volleyball Open Spike in the Elite Athletes

Fajar Awang Irawan[1], Dhias Fajar Widya Permana[2], Hadi[3], Syahru Romadhoni[4]

{fajarawang@mail.unnes.ac.id[1], dhiaspermana17@mail.unnes.ac.id[2],
hadi_pabbsi@mail.unnes.ac.id[3], syahru_fik@mail.unnes.ac.id[4]}

Department of Sport Science, Universitas Negeri Semarang[1,2], Department of Sport Coaching Education, Universitas Negeri Semarang[3,4]

Abstract. The aim of this study was to analyse the Open Spike motion in volleyball in the implementation of elite athletes perform in Semarang. This study used analytical research with One Short Case Design. This study was conducted at the Semarang volleyball association with 11 participants and all sample were agreed to participated in this study with full fill the inform consent. Study analysis using a video analysis software Dartfish version 8 and then processed to find kinematics data. This study found that Open Spike Volleyball in Semarang elite athletes is in a good category. The data showed that the average of the open spike time was 1.01 second and impact was 0.57 second. These results stated that open spike in this study was in the category quite appropriate the biomechanics aspect. The limitation in this study was only measure the kinematics data, and for future research, hopefully future research measure kinetics data on the arm power and leg power to the open spike.

Keywords: motion analysis, kinetics, open spike, volleyball

1 Introduction

Volleyball is a team game using a large ball and played by two teams facing each other and each team contain six people [1]. Volleyball is one of the sports that are known by all levels of society to the world, the reason was volleyball has been competed a lot [2]. The Indonesian men's national volleyball team in February 2020 was ranked 70th in the FIVB World Ranking. Therefore, volleyball athlete in Indonesia must also develop skills in volleyball games in order to provide better performance. Palao et al., (2004) stated that competing abilities or levels affect the appearance of the displayed skills [3]. The higher level of the athletes or a team that will compete, it will have an impact on the level of play and the technical appearance will be displayed by the athlete in the game. If athletes do not dominate the good technique, it will allow technical errors which are certainly very determined to the team. One way to improve achievement it is to always practice with the right technique or movement and have maximum results in a volleyball game. Thus, mastery of basic technique must be optimized.

There are several basic techniques in volleyball game, according to Sujarwo (2009) volleyball has at least 6 basic techniques that must be mastered by everyone who will play it [4]. The 6

basic techniques in the volleyball game are: serve, forearm pass, overhand pass, smash, block, and sliding. Meanwhile, according to Gintungan & Kembangbahu, (2016) the basic techniques consist of passing, service, block, and smash. Novia et al., (2020) explained that volleyball consist of seven basic game phases (serve, pass, set, spike, attack coverage, block and field defence) [5][6]. Some of basic techniques have been mentioned that when team in volleyball wants to win they have to collect as many points as possible, where volleyball players need to master attacking techniques and strategies to win. Dearing, (2019) convey attacking is pleasant and a good place to start because almost everyone likes the idea of floating over the net and slamming the ball into the field [7]. Similarly, Huang and Liu, (2000) said spike volleyball as one of the most important offensive weapons in competition. The technique in attacking is usually called a smash or spike to carry out an attack there are 3 movements that must be done, among others running, jumping, and hovering. The aim of the attack is to hit and reach the ball while it is in the air at high speed to kill the ball and get points in the game. The spike technique has several kinds, namely Open Spike, Semi Spike, Quick Spike, and Back Attack Spike Bujang et al., (2019) [8]. Spike movement is a very dangerous weapon and very useful in volleyball games to make it difficult for opponents to overcome the movement of the ball. Besides that, there are three spikes; high spike, slow spike and hard spike. The most famous spike movement is open spike because very complicated so a lot of practice is needed in the long term.

Based on Serrien et al., (2016) the Open Spike Volleyball technique devided into several stages that must be considered , namely preparation, prefix, repulsion, stroke, and landing [9]. According to Santoso et., al., (2018) Open Spike carried out when the position of the ball scores high enough that is more than 3 meters and the ball is in a calm state [10]. The open spike movement requires a lot of energy and can make players tiresd quickly, therefore the physical condition of volleyball players must always be in the best performance because it will affect the Open Spike Movement. Rahayu et al., (2018) conveyed several factors that can affect the Open Spike movement, including prefixes, repulsions, snap, and landings [11]. Thus, the attacking movement is very dominant or mostly done in volleyball games rather than defensive movements. In observations on volleyball elite athletes in Semarang that 80% of athletes are feel less appropriate in performing Open Spike movement, they are not suitable for doing Open Spike movements that are carried out are felt incomplete because the movements are done carelessly or they still don't understand the Open Spike movement, the athlete should be able to do correctly and be accompanied by the Open Spike technique in the optimal movement perform.

1.1 Objectives

Based on the research that has been done and from observation data that the Semarang volleyball elite athletes have not been optimal in carrying out the Open Spike movement so it is very necessary to get the targeted achievement so they must mastering attacks, and one of that is Open Spike. The purpose of this study was to analyse the Open Spike motion of volleyball in the implementation of achievement development in Volleyball athletes in Semarang. Therefore, the authors are interested in conducting research related to Open Spike Volleyball Motion Analysis in the Implementation of Achievement Development in Volleyball Athletes in Semarang. And hope that this research can be useful for volleyball athletes and for coaches so that they can be used as evaluations.

2 Literature review

In a previous study entitled Analysis of Open Smash Technique in Volleyball Coaching College Students by Putra et al., (2021) which was published on June 22, 2021 with result based on the result of analysis and discussion that the average open smash technique at the initial stage of taking where the distance from the net is 3.47 m, with a 3-step approach, arm swing angle 87, leg angle 149, elbow angle 80, back angle, jump height 53 cm, at a distance of ball and hand which is about 35 cm high and lands on 2 feet [12]. With an evaluation note that trainers can develop Open Spike techniques using kinesiology applications to be able to analyse Open Spike movements, trainers can provide practice based on biomechanical theory and for researchers to develop and continue aspect that influence Open Spike movements. Previous researcher who discussed the Open Spike ability were also conveyed by Wagner et al., (2009) where the research was to determine the effect of upper and lower extremities on the Open Spike Jump movement in volleyball [13]. The result obtained are that the importance of optimizing the correct technical approach to get maximum results at jump height in Open Spike jump performance is very important.

3 Methods

This study using analytical research with One Short Case Design. This study was conducted at the Badminton Association City Council of PBVSI Semarang City. This study used a motion analyses instrument to find out every detail of the kinematic data of volleyball athletes in Semarang City. The population in this study amounted 11 athletes with the sample in this study being male volleyball elite athletes from Semarang who made preparations for the 2022 Province Sports Event (PORPROV). All participants were in good health in accordance with the health protocol Covid-19 and according to the Ethical Clearance at KPEK and also not suffering from any injuries.

4 Data collection

The sampling technique in this study used a total sampling technique that all athlete actively participated in this study. All athletes in this study were asked to full fill the identity and informed consent forms in requirement to participate in this study. Data collection in this study using video recordings with analysis using Dartfis series 8.0. The kinematic data used in the study consisted of time, speed, distance, and body segment angle. The data is then presented with previous research data to obtain new findings and recommendations for the research conducted.

5 Results and discussion

The result of this study focuses on kinematic data in the Open Spike movement technique in volleyball. The data includes speed, distance, time, and body segment angles. The description

of the research in the analysis of open spike movements in volleyball elite athletes in Semarang is presented in table 1 below. The result of the research data obtained are as follows:

Table 1. Athletes Personal Data

n = 11	Mean ± SD	Minimum	Maximum
Age (Year)	18,9 ± 2,662	12	22
Height (Meter)	1,73 ± 0,063	1,618	1,815
Weight (Kilogram)	68 ± 8,852	49	80
BMI (Kg/m^2)	23 ± 2,386	18	26

The study data was obtained with a sample of 11 volleyball athletes in the Semarang. The data description of the average age of the sample is 18,9 ± 2,662 years, with an average height of 1,73 ± 0,063 m, an average of weight of 69 ± 8,852 kg, and an average BMI (Body Mass Index) of 23 ± 2,386 kg/m2. The data results, 11 samples of volleyball athletes in Semarang are shown in table 1 with minimum age of 12 years and a maximum age of 22 years. The minimum height is 1,618 meters and the maximum is 1,815 meters. Minimum weight 49 kg and maximum 80 kg. and BMI with a minimum of 18 kg/m2 and maximum 26 kg/m2.

The researcher analysed kinematic data which consisted of stroke speed, time, jump heigh, leg flexion angle, trunk extension angle, arm rotation angle, and elbow flexion angle. Kinematic data is presented in table 2.

Table 2. Kinematics result of Open Spike Volleyball Technique

Indicators	Mean ± SD	Min	Max
Open Spike Speed (m/s)	1,26 ± 0,380	0,57	1,92
Open Spike Time (s)	1,98 ± 0,138	1,78	2,32
Distance of Repulsion to Landing (m)	2,49 ± 0,750	1,15	3,74
Initial Phase			
Leg Flexion Angle (°)	129,2 ± 39,667	26	163,9
Angle of Torso Extension (°)	164,7 ± 9,225	152,3	179,2
Rejection to Landing Distance (°)	25,8 ± 20,563	3	75,1
Repulsion Phase			
Repulsion Time (s)	1,01 ± 0,134	0,86	1,28
Leg Flexion Angle (°)	103,5 ± 7467	89,2	116,8
Angle of Torso Extension (°)	157,7 ± 11,801	133,5	174,5
Arm Rotation Angle (°)	40,5 ± 24,960	7	77,3
Elbow Flexion Angle (°)	153 ± 18,027	128,1	177,4
Impact Phase			
Impact Time (s)	0,57 ± 0,028	0,5	0,62
Jump Height (m)	4,8 ± 1,510	3,54	7,12
Leg Extension Angle (°)	147,8 ± 28,695	99,6	179,7
Angle of Torso Extension (°)	167,1 ± 11,92	144	178,8
Arm Rotation Angle (°)	160,3 ± 14,789	127,4	178,4
Elbow Flexion Angle (°)	166,4 ± 6,178	155,4	178,9

Landing Phase			
Landing Time (s)	0,39 ± 0,075	0,3	0,56
Leg Flexion Angle (°)	141,3 ± 28,531	89,2	178,8
Angle of Torso Extension (°)	159,8 ± 14,073	129	176,4
Arm Rotation Angle (°)	47,3 ± 14,073	17,1	139,5
Elbow Flexion Angle (°)	179,9 ± 36,354	67	179,9

Table 2 describes the Open Spike technique in study divided into several phases consisting of; 1) initial phase, 2) repulsion phase, 3) impact phase and 4) landing phase. The data from the kinematic analysis of the Open Spike technique shows that the average Open Spike speed is 1,26 ± 0,380 m/s, the Open Spike circuit time is 1,98 ± 0,138 s, and the distance from repulsion to landing is 2,49 ± 0,750 m. the Open Spike technique performed in the initial phase showed a leg flexion angle of 129,2 ± 39,667° , an angle of torso extension of 164,7 ± 9,225° , and an arm rotation angle of 25,8 ± 20,563°. In the repulsion phase, the repulsion time is 1,01 ± 0,134 second, the leg flexion angle is 103,5 ± 7467°, the trunk extension angle is 157,7 ± 11,801°, the arm rotation angle is 40,5 ± 24,960°, and the elbow flexion angle is 153 ± 18,027°. In the impact phase, the impact time is 0,57 ± 0,028 second, the jump heigh is 4,8 ± 1,510 meter, the leg extension angle is 147,8 ± 28,695° , and the elbow flexion angle is 166,4 ± 6,178°. While in the landing phase, the landing time is 0,39 ± 0,075 second, the trunk extension angle is 141,3 ± 28,531, the angle of torso extension is 159,8 ± 14,073°, the arm rotation angle is 47,3 ± 34,867° , and elbow flexion angle is 179,9 ± 36,354°.

The Open Spike technique for volleyball inn Semarang has been measured based on the Open Spike indicator as described above, namely four phases including: 1) initial phase, 2) the repulsion phase, 3) the impact phase, and 4) the landing phase. The result of the kinematic data is presented in table 2 with the speed indicator presented in the following figure.
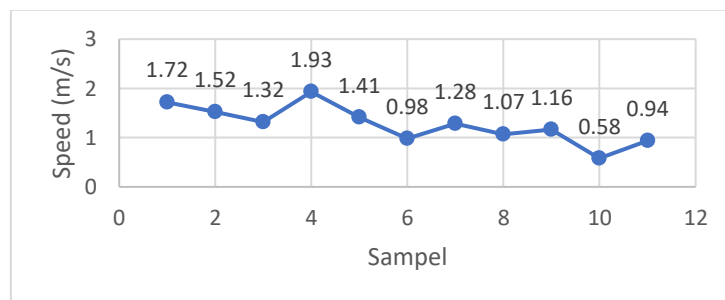

Fig. 1. Open Spike Data for Volleyball Elite Athletes

Figure 1 showed the result of the Open Spike speed Volleyball athletes in Semarang. The highest speed value is shown by sample 4 with a result of 1,93 m/s and the lowest velocity value is shown by sample 10 with a result of 0,58 m/s. the other result are shown in sample 1 with a yield of 1,72 m/s, sample 2 1,52 m/s, sample 3 1,32 m/s, sample 4 1,93 m/s, sample 5 1,41 m/s, sample 6 0,98 m/s, sample 7 1,28 m/s, sample 8 1,07 m/s, and then sample 9 with the result 0,58 m/s, and the last sample 11 0,94 m/s.

This study counts 2 steps before doing the repulsion. At the end there will be a change in speed to acceleration because the last step will be longer when doing repulsion. The final step

length in the study was not calculated, it was replaced by calculating the distance from the repulsion position to the landing position. To find out the distance from repulsion to landing, the author presents the distance from repulsion to landing in figure 4 below.
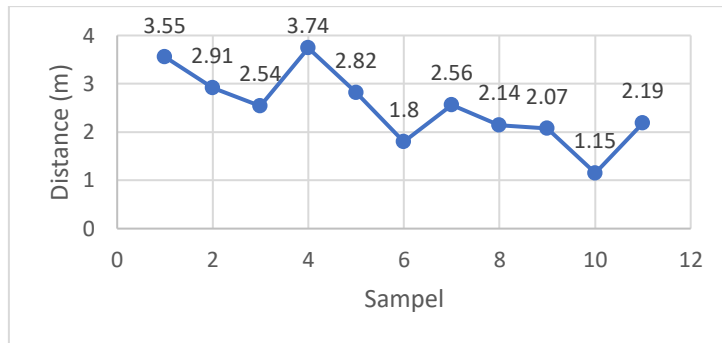

Fig. 2. Repulsion Distance Data to Landing

In this study there are the results of the shortest and farthest values, the shortest result on the distance of repulsion to landing is shown by sample 10 with a result of 1,15 m for the farthest distance of repulsion shown in sample 4 with a result 3,74. For all the result shown in figure 4 on sample 1 3,55 m, on sample 2 2,91 m, on sample 3 with the result of 2,54 m, sample 4 3,74 m, sample 5 2,82 m, sample 6 1,8 m, sample 7 2,56 m, sample 8 with the result of 2,14m, sample 9 2,07m, sample 10 1,5 m, sample 11 2,19 m. when performing a footstep in the initial phase, the long stride and the small angle of the torso help position the heel of the dominant foot further forward. This helps in efficient movement towards the repulsion phase. The results of this study showed that the angle of extension of the trunk of the body in the repulsion phase is $157,7 \pm 11,801°$.

Researchers calculate the Open Spike time by grouping it into 4 based on stages, namely repulsion, impact, landing and series or overall time. In the initial phase, time is not counted because in that position only preparations are made to prepare for the initial movement, namely stepping. The Open Spike time series data for this study is presented in the image below :
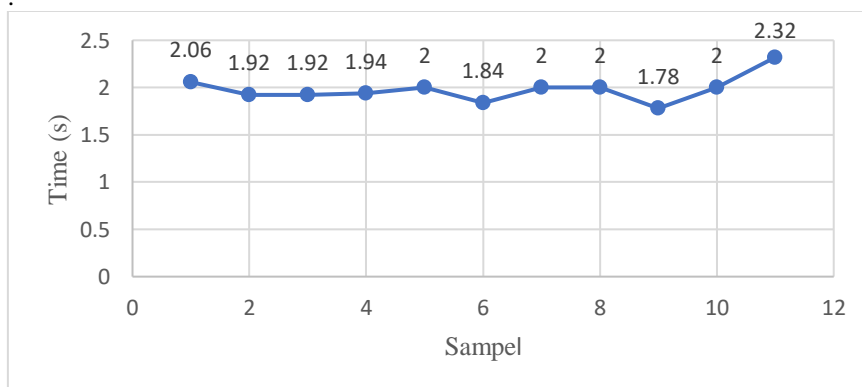
Fig. 3. Time Data of Open Spike Volleyball Athletes in Semarang

Figure 3 shows the Open Spike circuit time with the results, sample 1 2,06 seconds, sample 2 1,92 seconds, sample 3 1,92 seconds, sample 4 1,94 seconds, sample 5 2,00 seconds, sample 6 1,84 seconds, sample 7 2,00 seconds, sample 8 2,00 seconds, sample 9 1,78 seconds, sample 10 2,00 seconds, and sample 11 with the result 2,32 seconds. The results of the time series get the largest and the smallest value, for the smallest value of 1,78 seconds obtained by sample 9 and for the largest result obtained by sample 11 which is 2.32 seconds. The result of the time data based on the Open Spike phase are presented in figure 6.
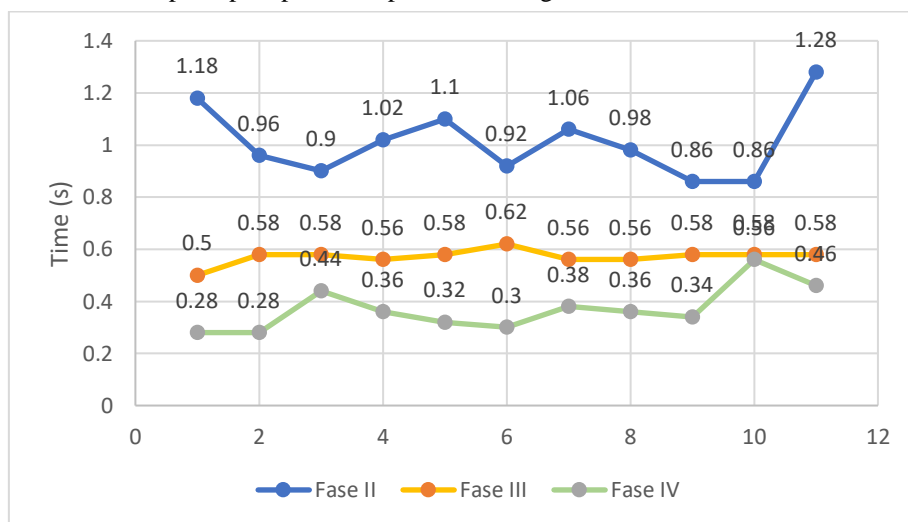
Fig. 4. Open Spike Time Data Based Phases of Semarang Volleyball Athletes

The distribution of the Open Spikes time in figure 4 is grouped based on the open Spike phase, namely repulsion phase, impact phase, and landing phase. The results of the time in the repulsion phase are: sample 1 with a time of 1.18 seconds, sample 2 0,96 seconds, sample 3 0,90 seconds, sample 4 with of 1.02 seconds, sample 5 with a time of 1.10 seconds, sample 6 0,92 seconds, sample 8 0.98 seconds, sample 9 and 10 0,86 seconds, and sample 11 with a time of 1,28 seconds. The Open Spike in impact phase results in sample 1 requiring 0,50 seconds, sample 2 0,58 seconds, sample 3 0,58 seconds, sample 4 0,56 seconds, sample 5 0,58 seconds, sample 6 0,62 seconds, sample 7 0,56 seconds, sample 8 0,56 seconds, sample 9 takes 0,58 seconds, sample 10 0,56 seconds, and sample 11 with a time of 0,46 seconds.

The repulsion phase is marked by the player doing a repulsion from the dominant foot position as a support and the knee forming a flexion angle. Dominant foot support when doing a push supported by good lower leg muscle strength will form a leg flexion angle that reproduces as well, so that the resulting jump will be higher. The results showed that the leg flexion angle in the repulsion phase was on average $103,5 \pm 746,7°$ with the dominant foot as the right foot support. The position of the legs that is not too wide during the push helps the athlete to transfer speed efficiently for jumping. The result of the segment angle in the repulsion phase, the angle of the trunk extension $157,7 \pm 11,801°$. The rotation angle of the arm $40,5 \pm 24,960°$ and the elbow flexion angle of $153 \pm 18,027°$. If the lower leg flexion angle is smaller, it can be influenced by lower leg muscle strength which will affect the jump height.

Previous research on the motion analysis of the volleyball spike by Serrien et al., (2016) explained that the analysis for man and women of elite junior volleyball players in spikes, namely offensive actions is very important [9]. Senior class players have a higher impact speed and jump height than juniors. For three-dimensional kinematic analysis of the pelvis, torso, shoulders, elbow angle and angular velocity, parametric mapping statistic were used. The initial step on the spike will have an impact on the force generated when taking off [10]. Previous research conducted by Kuhlmann et al., (2007) regarding aspects of Open Spike analysis in high-level competitions revealed that to achieve higher jump heights it seems useful to emphasize jumping technique training it is possible to perform faster vertical speeds during take-off with practice jump coordination [14]. Also related Zahálka et al., (2017) that explosive movements and vertical jumps are carried out during repulsion [15]. To be able to do an open spike, several determining factors are needed, namely : (1) preparatory steps or prefixes, (2) repulsion or jumps, (3) hitting the ball when the ball is in the air, (4) landing [16]. Open Spike volleyball games will not be able to do a counter-attack spike strongly and deliberately without being supported by the ability of the joints of the body, shoulders, legs, and arms [17]. Based on statement above, it is necessary for players to always pay attention to the right techniques. Before doing an Open Spike, an athlete must find the right momentum to execute a pass into points. During the hovering position or before entering the impact phase, the dominant arm used to perform the Open Spike is focused on taking the prefix and preparing energy first, while the other hand aims at the ball positions at the arm rotation angle, the arm rotation angle in this study is $160,3 \pm 14,789°$.

Regarding the speed of the ball on the arm through the momentum of the upper body it is not based on the strength in the shoulder joint but because of the coordinator between the arm and the upper body [18].the result showed that the loss of leg extension in the impact phase was $147,8 \pm 28,695°$ with a trunk angle of $167,1 \pm 11,92°$. The arm flexion angle by Pramantiara & Herdyanto, (2018) obtained 63 degrees, measured when the athlete is in the Open Spike position, where the arm flexion angle produces optimal power [19]. In contrast to this study, which formed a flexion angle based on when the subject's arm touched the impact ball with a magnitude of $166,4 \pm 6,178$ degrees.

Knowledge of biomechanics in sports [20][21] can help improve performance and detect injuries as early as possible Pramantiara & Herdyanto, (2018). In addition, an understanding of the correctness of the motion of a technique [19] to achieve maximum results must be given to athletes. The researcher's recommendation is to be able to provide good footwork pattern exercises, namely with a single line step pattern. This will help athletes in producing maximum power. You can also train leg muscle power with the squat jump exercise method to increase jump power and timing in Open Spike.

6 Conclusion

The conclusion in this study found that the analysis of open spike volleyball motion in the volleyball elite athletes is in a good category with the open spike time was 1.01 second and impact was 0.57 second. These results stated that open spike in this study was in the category quite appropriate the biomechanics aspect. The limitation in this study was only measure the

kinematics data, and for future research, hopefully future research measure kinetics data on the arm power and leg power to the open spike.

References

[1] Nopembri, S. dan S. (2014). Pendidikan Jasmani, Olahraga dan Kesehatan. Katalog Dalam Terbitan.

[2] Astuti, S. I., Arso, S. P., & Wigati, P. A. (2020). Pembelajaran Bola Voli. In N. Anggara & N. Asri (Eds.), Analisis Standar Pelayanan Minimal Pada Instalasi Rawat Jalan di RSUD Kota Semarang (Vol. 3). Bening media PUBLISHING.

[3] Palao, J. M., Santos, J. A., & Ureña, A. (2004). Effect of team level on performance of skills in volleyball. International Journal of Performance Analysis in Sport, 4(2), 50–60.

[4] Sujarwo, S. (2009). Volleyball For All.

[5] Gintungan, S. D. N., & Kembangbahu, I. K. (2016). Kegiatan Ekstrakurikuler Kepramukaan. Pendidikan Jasmani, 26, 133–140.

[6] Novia, V., Putri, E., & Karya, U. M. (2020). Analisis Spike Atlet Bola Voli Pasir Indonesia. Jurnal Muara Olahraga Vol., 3(1), 36–45.

[7] Dearing, J. (2018). Volleyball Fundamentals (2E ed.). Human Kinetics.

[8] Bujang, Maya, N. D. T., & Velyan, M. Y. (2019). Effect of Leg Power, Arm Power, Eyes and Foot Coordination and Self Confidence on Back Attack Smash in Volleyball. 2nd International Conference on Sports Sciences and Health 2018 (ICSSH 2018) Effect, 7, 42–45.

[9] Serrien, B., Ooijen, J., Goossens, M., & Baeyens, J.-P. (2016). A Motion Analysis in the Volleyball Spike - Part 1: Three-dimensional Kinematics and Performance. International Journal of Human Movement and Sports Sciences, 4(4), 70–82. https://doi.org/10.13189/saj.2016.0403

[10] Santoso, D. A., & Qiram, I. (2018). Analisis Biomekanika Jarak Langkah Take Off Open Spike Dalam Bolavoli. Prosiding Seminar Nasional IPTEK Olahraga, 8–10.

[11] Rahayu, S., Handayanto, S. K., Zulaikah, S., & Ahda, S. (2018). Students' regulation of cognition in physics problem-solving. IOP Conf. Series: Journal of Physics: Conf. Series 1097 (2018) 012029, 1–8. https://doi.org/10.1088/1742-6596/1097/1/012029

[12] Putra, M. E., Supriatna, E., Dwi, I., & Wati, P. (2021). KOMPETITOR : Jurnal Pendidikan Kepelatihan Olahraga Analysis of Open Smash Techniques in Volleyball Coaching College Students. 13(2), 262–269.

[13] Wagner, H., Tilp, M., Von Duvillard, S. P. V., & Mueller, E. (2009). Kinematic analysis of volleyball spike jump. International Journal of Sports Medicine, 30(10), 760–765. https://doi.org/10.1055/s-0029-1224177

[14] Kuhlmann, C., Roemer, K., & Milani, T. L. (2007). Aspects of A Three Dimentional Motion Analysis of The Volleyball Spike in High Level Competition. XXV ISBS Symposium, 47–50.

[15] Zahálka, F., Malý, T., Malá, L., Ejem, M., & Zawartka, M. (2017). Kinematic Analysis of Volleyball Attack in the Net Center with Various Types of Take-Off. Journal of Human Kinetics, 58(September), 261–271. https://doi.org/10.1515/hukin-2017-0115

[16] Zinat, I. (2016). Hubungan Antara Power Tungkai, Koordinasi Mata-Tangan, dan Rasa Percaya Diri dengan Hasil Keterampilan Open Spike Bola Voli. 4 no 1(2338–2996), 78–89.

[17] Bujang, & Haqiyah, A. (2020). Physical Condition and Self-Control Improves the Ability of Back Attack in Volleyball. 1st South Borneo International Conference on Sport Science and Education (SBICSSE 2019), 407, 31–34.

[18] Fuchs, P. X., Mitteregger, J., Hoelbling, D., Menzel, H. J. K., Bell, J. W., von Duvillard, S. P., & Wagner, H. (2021). Relationship between general jump types and spike jump performance in elite female and male volleyball players. Applied Sciences (Switzerland), 11(3), 1–8. https://doi.org/10.3390/app11031105

[19] Pramantiara, N. Y., & Herdyanto, Y. (2018). Analisis Gerak Smash Rivan Nurmulki Pada Bolavoli di Final Proliga 2018. 61–65.

[20] Irawan, F. A., Nomi, M. T., & Peng, H. (2021). Pencak Silat Side Kick in Persinas ASAD : Biomechanics Analysis. International Journal of Human Movement and Sports Sciences, Vol.9(No.6), pp.1230-1235. https://doi.org/10.13189/saj.2021.090617

[21] Irawan, F. A., Jannah, S. P., Permana, D. F. W., Nurrachmad, L., & Anam, K. (2021). Mawashi Geri in Karate Junior Cadet Class : Kinematic Analysis. Journal of Hunan University, Vol.48(No.9), pp.437-443.

[22] Irawan, F. A., Toma, H. P., Permana, D. F. W., Suciati, N., & Gulsirirat, P. (2021). Motion Analysis of Long-Distance Drive in Woodball Athletes. ACPES Journal of Physical Education, SPort, and Health, Vol.1(No.2), pp.172-178. https://doi.org/DOI: https://doi.org/10.15294/ajpesh.v1i2.49972